SN74LS393

Dual 4-Stage Binary Counter

The SN74LS393 contains a pair of high-speed 4-stage ripple counters.

Each half of the LS393 operates as a Modulo-16 binary divider, with the last three stages triggered in a ripple fashion. In the LS393, the flip-flops are triggered by a HIGH-to-LOW transition of their CP inputs. Each half of each circuit type has a Master Reset input which responds to a HIGH signal by forcing all four outputs to the LOW state.

- Dual Versions
- Individual Asynchronous Clear for Each Counter
- Typical Max Count Frequency of 50 MHz
- Input Clamp Diodes Minimize High Speed Termination Effects

GUARANTEED OPERATING RANGES

Symbol	Parameter	Min	Typ	Max	Unit
V_{CC}	Supply Voltage	4.75	5.0	5.25	V
T_A	Operating Ambient Temperature Range	0	25	70	°C
I_{OH}	Output Current – High			–0.4	mA
I_{OL}	Output Current – Low			8.0	mA

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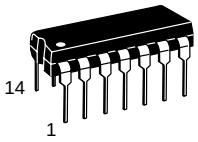
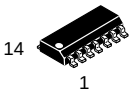
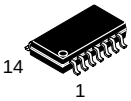
LOW POWER SCHOTTKY



PLASTIC
N SUFFIX
CASE 646



SOIC
D SUFFIX
CASE 751A



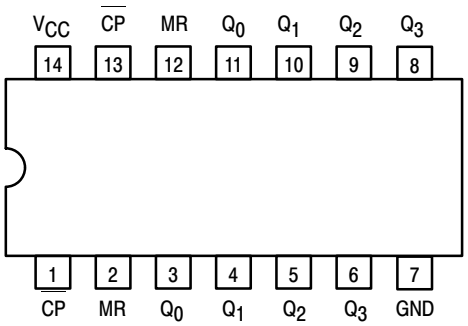
SOEIAJ
M SUFFIX
CASE 965

ORDERING INFORMATION

Device	Package	Shipping
SN74LS393N	14 Pin DIP	2000 Units/Box
SN74LS393D	SOIC–14	55 Units/Rail
SN74LS393DR2	SOIC–14	2500/Tape & Reel
SN74LS393M	SOEIAJ–14	See Note 1
SN74LS393MEL	SOEIAJ–14	See Note 1

1. For ordering information on the EIAJ version of the SOIC package, please contact your local ON Semiconductor representative.

CONNECTION DIAGRAM DIP (TOP VIEW)



NOTE:
The Flatpak version has the same pinouts (Connection Diagram) as the Dual In-Line Package.

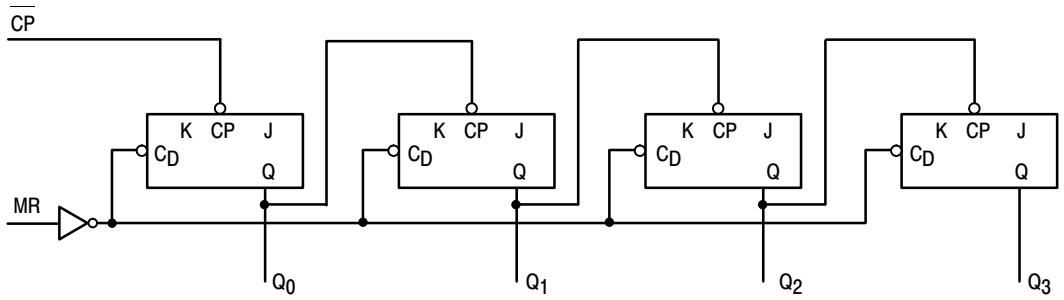
PIN NAMES		**LOADING** (Note a) HIGH	LOW
$\overline{CP}$	Clock (Active LOW Going Edge) Input to +16 (LS393)	0.5 U.L.	1.0 U.L.
$\overline{CP_0}$	Clock (Active LOW Going Edge) Input to ÷2 (LS390)	0.5 U.L.	1.0 U.L.
$\overline{CP_1}$	Clock (Active LOW Going Edge) Input to ÷ 5 (LS390)	0.5 U.L.	1.5 U.L.
MR	Master Reset (Active HIGH) Input	0.5 U.L.	0.25 U.L.
$Q_0 - Q_3$	Flip–Flop Outputs	10 U.L.	5 U.L.

NOTES:
a) 1 TTL Unit Load (U.L.) = 40 μA HIGH/1.6 mA LOW.

FUNCTIONAL DESCRIPTION

Each half of the SN74LS393 operates in the Modulo 16 binary sequence, as indicated in the ÷16 Truth Table. The first flip-flop is triggered by HIGH-to-LOW transitions of the CP input signal. Each of the other flip-flops is triggered by a HIGH-to-LOW transition of the Q output of the preceding flip-flop. Thus state changes of the Q outputs do not occur simultaneously. This means that logic signals derived from combinations of these outputs will be subject to decoding spikes and, therefore, should not be used as clocks for other counters, registers or flip-flops. A HIGH signal on MR forces all outputs to the LOW state and prevents counting.

SN74LS393 LOGIC DIAGRAM (one half shown)



TRUTH TABLE

COUNT	OUTPUTS			
	Q_3	Q_2	Q_1	Q_0
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
10	H	L	H	L
11	H	L	H	H
12	H	H	L	L
13	H	H	L	H
14	H	H	H	L
15	H	H	H	H

H = HIGH Voltage Level
L = LOW Voltage Level

DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

Symbol	Parameter		Limits Min	Typ	Max	Unit	Test Conditions	
V_{IH}	Input HIGH Voltage		2.0			V	Guaranteed Input HIGH Voltage for All Inputs	
V_{IL}	Input LOW Voltage				0.8	V	Guaranteed Input LOW Voltage for All Inputs	
V_{IK}	Input Clamp Diode Voltage			–0.65	–1.5	V	V_{CC} = MIN, I_{IN} = –18 mA	
V_{OH}	Output HIGH Voltage		2.7	3.5		V	V_{CC} = MIN, I_{OH} = MAX, V_{IN} = V_{IH} or V_{IL} per Truth Table	
V_{OL}	Output LOW Voltage			0.25	0.4	V	I_{OL} = 4.0 mA	V_{CC} = V_{CC} MIN, V_{IN} = V_{IL} or V_{IH} per Truth Table
				0.35	0.5	V	I_{OL} = 8.0 mA	
I_{IH}	Input HIGH Current				20	μA	V_{CC} = MAX, V_{IN} = 2.7 V	
					0.1	mA	V_{CC} = MAX, V_{IN} = 7.0 V	
I_{IL}	Input LOW Current	MR			–0.4	mA	V_{CC} = MAX, V_{IN} = 0.4 V	
		$\overline{CP}$, $\overline{CP_0}$			–1.6	mA		
		$\overline{CP_1}$			–2.4	mA		
I_{OS}	Short Circuit Current (Note 2)		–20		–100	mA	V_{CC} = MAX	
I_{CC}	Power Supply Current				26	mA	V_{CC} = MAX	

2. Not more than one output should be shorted at a time, nor for more than 1 second.

AC CHARACTERISTICS (T_A = 25°C, V_{CC} = 5.0 V)

Symbol	Parameter	Limits Min	Typ	Max	Unit	Test Conditions
f_{MAX}	Maximum Clock Frequency CP_0 to Q_0	25	35		MHz	C_L = 15 pF
f_{MAX}	Maximum Clock Frequency CP_1 to Q_1	20			MHz	
t_{PLH} t_{PHL}	Propagation Delay, CP to Q_0		12 13	20 20	ns	
t_{PLH} t_{PHL}	$\overline{CP}$ to Q_3		40 40	60 60	ns	
t_{PHL}	MR to Any Output		24	39	ns	

AC SETUP REQUIREMENTS (T_A = 25°C, V_{CC} = 5.0 V)

Symbol	Parameter	Limits Min	Typ	Max	Unit	Test Conditions
t_W	Clock Pulse Width	20			ns	V_{CC} = 5.0 V
t_W	MR Pulse Width	20			ns	
t_{rec}	Recovery Time	25			ns	

AC WAVEFORMS

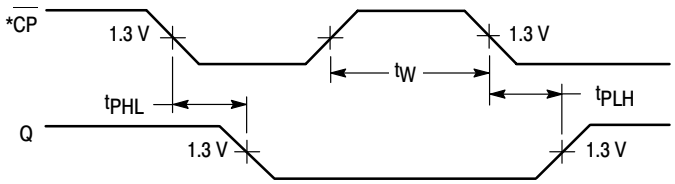


Figure 1.

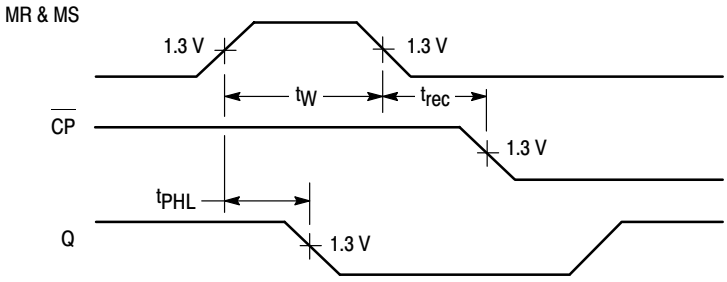
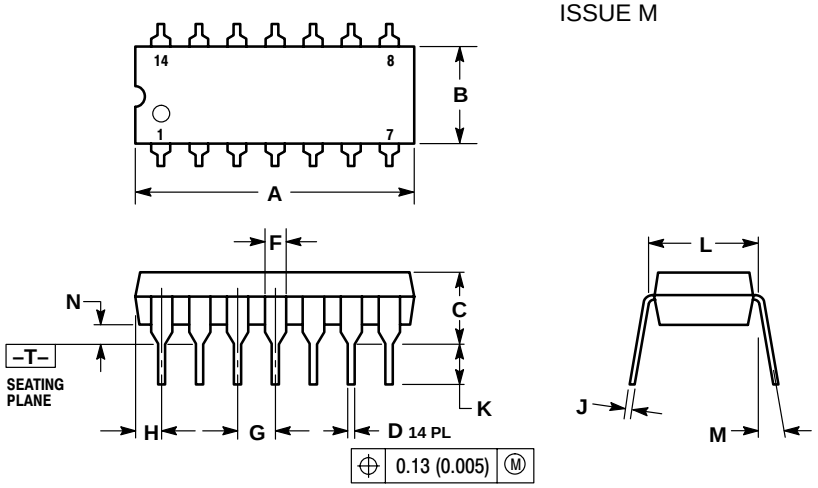


Figure 2.

***The number of Clock Pulses required between t_{PHL} and t_{PLH} measurements can be determined from the appropriate Truth Table.**

PACKAGE DIMENSIONS

N SUFFIX
PLASTIC PACKAGE
CASE 646–06
ISSUE M

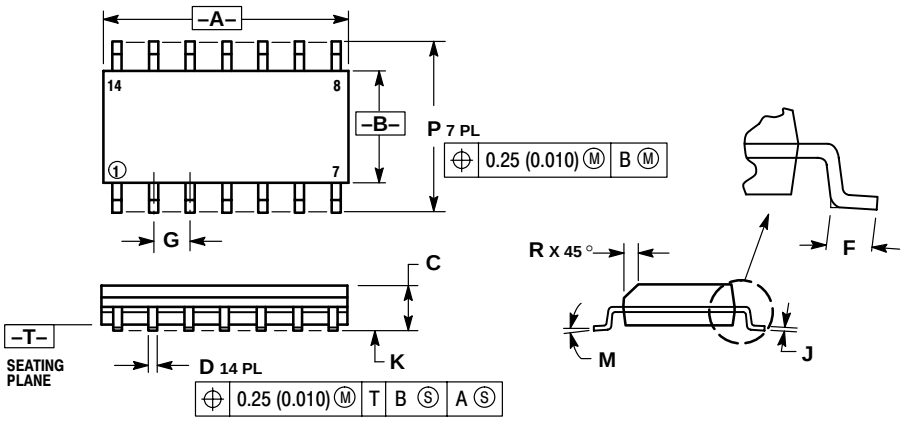


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.715	0.770	18.16	18.80
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC		2.54 BSC	
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.290	0.310	7.37	7.87
M	---	10°	---	10°
N	0.015	0.039	0.38	1.01

PACKAGE DIMENSIONS

D SUFFIX
PLASTIC SOIC PACKAGE
CASE 751A–03
ISSUE F

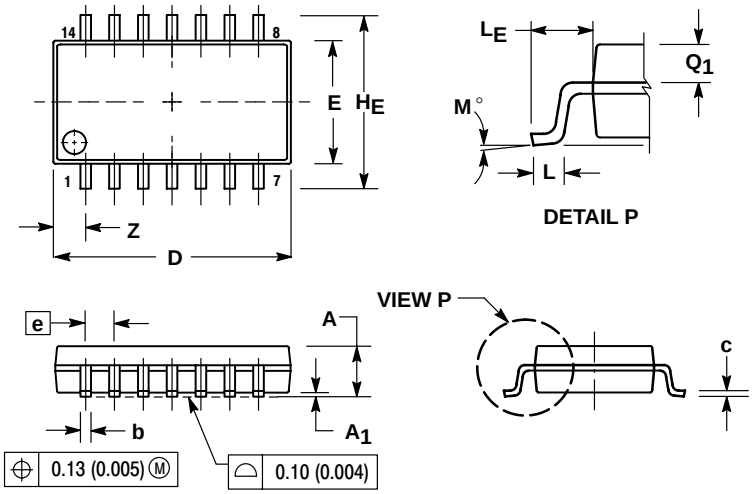


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0 °	7 °	0 °	7 °
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

PACKAGE DIMENSIONS

M SUFFIX
SOEIAJ PACKAGE
CASE 965–01
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	---	2.05	---	0.081
A_1	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.18	0.27	0.007	0.011
D	9.90	10.50	0.390	0.413
E	5.10	5.45	0.201	0.215
e	1.27 BSC		0.050 BSC	
H_E	7.40	8.20	0.291	0.323
0.50	0.50	0.85	0.020	0.033
L_E	1.10	1.50	0.043	0.059
M	0 °	10 °	0 °	10 °
Q_1	0.70	0.90	0.028	0.035
Z	---	1.42	---	0.056

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